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Controlled Field Test of Stabilized Pyrethrins Against the Western Hemlock Looper

by

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The Kenya Pyrethrum Company of Newark, N. J., furnished the stabilized pyrethrins and financed most of the experiment. Field aspects of the test were made possible by the cooperation of R. G. Mitchell, C. Sartwell, T. C. Tigner, H. G. Paul, and V. M. Carolin of the Pacific Northwest Forest and Range Experiment Station. Appreciation is also extended to L. F. Pettinger, J. Mounts, and others of Region 6, U.S. Forest Service, for their cooperation on many phases of the test and to R. DeWitz of the Mount Baker National Forest for photography.

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ABSTRACT

A new stabilized formulation of pyrethrins was field tested against larvae of the western hemlock looper by spraying from a helicopter. A selected number of larvae were placed in foliage on platforms where they were fully exposed to the spray and on small trees where they were partially screened from direct spray contact. Ninety-nine percent and 94 percent of the larvae on the platforms and on the trees, respectively, were paralyzed or killed by the insecticide. Most of the larvae fully exposed on the platforms were knocked down within a few minutes after spraying, whereas knockdown of larvae in the trees occurred over a considerably longer period of time. Recovery rate of paralyzed larvae was higher for those that were slow to be knocked down than for larvae knocked down quickly.

INTRODUCTION

Pyrethrins are natural insecticidal compounds usually extracted from flowers of the pyrethrum plant, *Chrysanthemum cinerariaefolium* Vis. They are highly toxic to many lepidopterous defoliators including the western hemlock looper, *Lambdina fiscellaria lugubrosa* (Hulst). Moreover, they have a low level of toxicity to mammals and are generally regarded as among the safest of insecticides. However, because of their rapid deterioration in sunlight, previous formulations of pyrethrins have been of little value in controlling forest defoliators.

Recently, a stabilized formulation of the pyrethrins has shown promise of maintaining toxicity in direct sunlight for a much longer period of time. Accordingly, a field test was conducted to determine whether this new formulation of pyrethrins was durable when applied by helicopter in a natural forest situation and whether it had promise as a control for the western hemlock looper.

EXPERIMENTAL METHODS

The insecticide used was a new stabilized formulation of pyrethrins developed at the Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.[1]

The test formulation, furnished by the Kenya Pyrethrum Company of Newark, N. J., was applied by helicopter at the rate of 0.1 pound active ingredient in one-half gallon mineral oil per acre. Based on pressure in the spray system and size of nozzles, the delivered droplet size was estimated to be 120 μ mass median diameter (mmd).

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[1] A patent for the stabilized pyrethrins is pending. The authors of the patent are Raymond P. Miskus and Theresa L. Andrews.

The tests were conducted on July 10, 1969, in the vicinity of a natural outbreak of the hemlock looper on the Mount Baker National Forest near Marblemount, Wash. The spray was applied in the early afternoon during a light rain. Due to low clouds and cool temperatures (∿ 60° F.), the air was reasonably stable which allowed for good spray coverage of the test area. Nevertheless, foliage in the area was very wet, a factor that should be considered in the evaluation of results.

Two methods were used to evaluate the performance of the formulation against the hemlock looper: (1) the effect on larvae on small hemlock trees, and (2) the effect on larvae on specially arranged foliage on small platforms fully exposed to the spray.

Fifteen stations were established over a 6-acre area in a former clearcut. At each station we located a single hemlock tree 7 to 10 feet in height, erected a pair of wooden platforms (fig. 1), and put a plastic drop cloth under each tree to catch larvae dropping from the foliage (fig. 2A). The platform was a 16-inch-square of 1/4-inch plywood mounted on a short post 4 to 5 feet above the ground. A wire rack was attached to the platform to support several small branches of hemlock foliage about 4 inches above the surface. A tanglefoot barrier around the edge of the plywood prevented the escape of healthy larvae (fig. 2B).

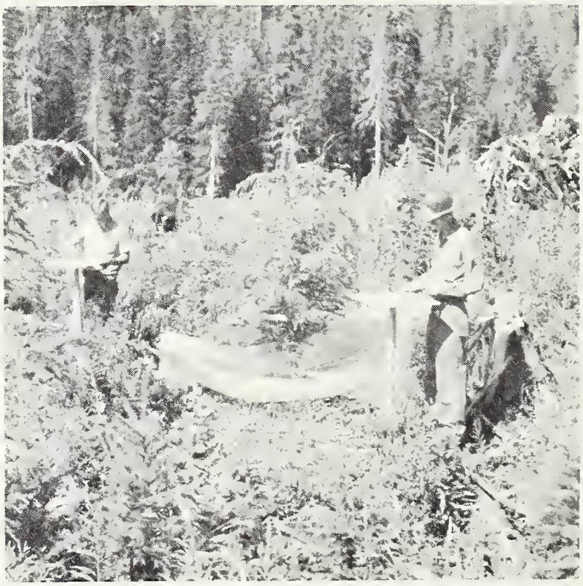

Figure 1.--One of 15 stations consisting of one small hemlock tree and two paired platforms used for evaluating effect of stabilized pyrethrins on hemlock looper.

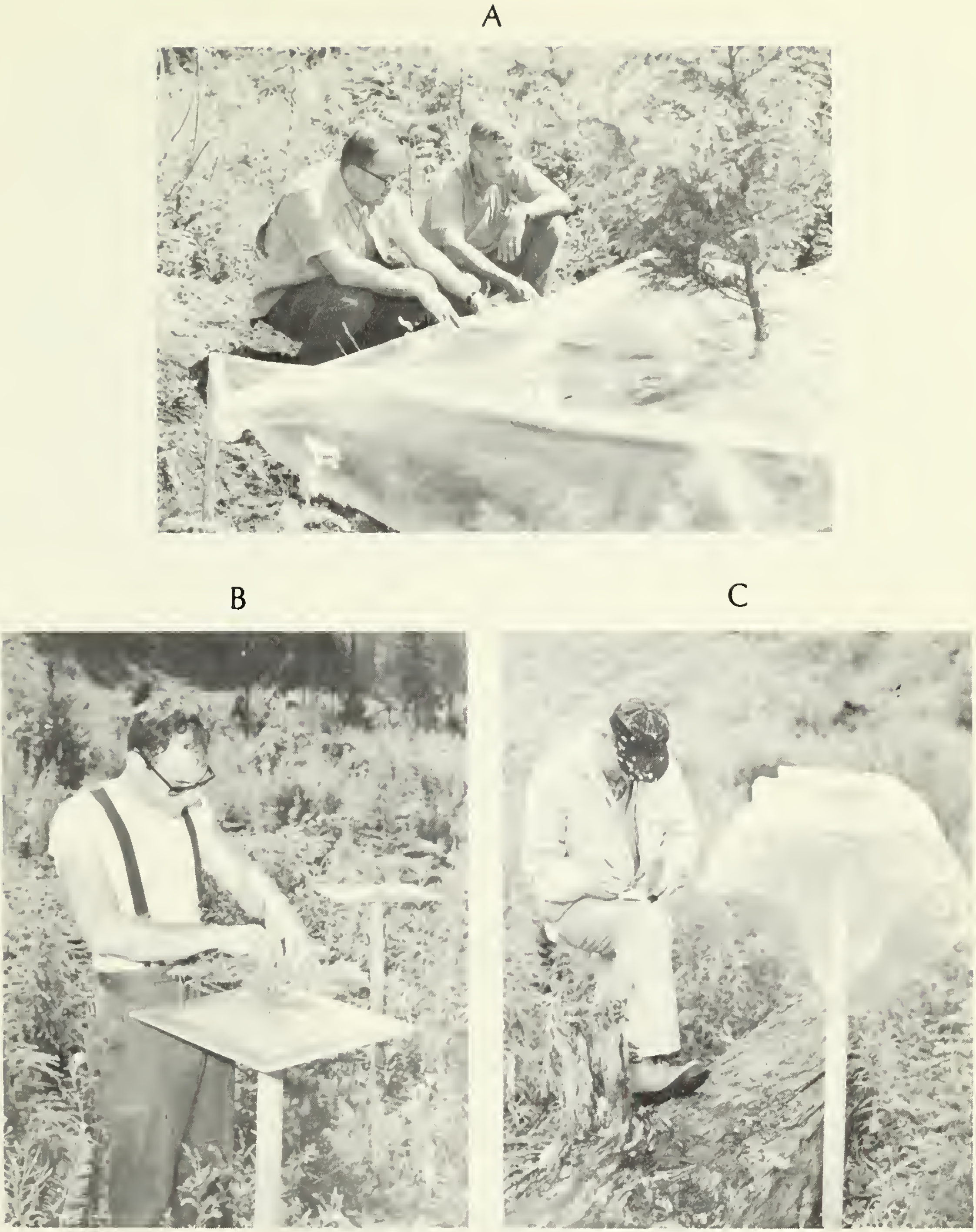

Figure 2.--Field techniques for evaluation used at each station. **A**, Hemlock tree with plastic drop cloth for catching paralyzed and killed larvae; **B**, platform with wire rack for supporting foliage with larvae fully exposed to spray; **C**, platform covered with plastic bag used as a control during spraying of test area.

Before treatment, the trees and platforms were stocked with hemlock looper larvae, most of which were in the second and third instars, which had been collected previously from the surrounding natural infestation. One hundred larvae were placed on each of the 15 trees 4 hours before spraying and 20 larvae on each of the 30 platforms one-half hour prior to spraying. One platform at each station was used as a control and covered with a light plastic bag during spraying (fig. 2C). The bag was removed about 1 hour after spraying.

Effectiveness of the spray was evaluated by determining the initial knockdown of larvae and by later separation of those actually dead from those showing sublethal effects. Knockdown refers to larvae that were paralyzed by the spray and either dropped off or became lodged in the foliage. It was determined from a tally of all larvae that dropped off the foliage at intervals of 15 minutes, 30 minutes, and 1, 2, 3, and 4 hours after spraying. Larvae which had not dropped from the foliage after 4 hours were dislodged by shaking the tree. Sublethal knockdown was distinguished from mortality by collecting fallen larvae in separate 8-ounce cartons for each time interval and observing them later. The study was terminated 19 hours after spraying when all larvae in the cartons were examined and classified according to whether they were dead, paralyzed, or apparently fully recovered.

RESULTS

Of the larvae placed on trees, only 69 percent or 1,032 of 1,500 could be accounted for in the final count. By comparison, 91 percent (273 of 300) of larvae placed on treated platforms and 88 percent (265 of 300) of larvae placed on control platforms were recovered. Predatory ants on the trees probably removed many of the larvae shortly after the trees were stocked. Other larvae unaccounted for could have been lost in the folds of the plastic drop cloth or become firmly lodged in the wet foliage.

Four hours after spraying, 94 percent of the larvae on trees and 99 percent on the treated platforms were either dead or paralyzed by the treatment, compared with only 6 percent on the control platforms. Sixty-three percent of the larvae on the trees and 75 percent on the platforms actually dropped off the foliage.

The actual patterns of drop off are shown by the solid lines in figure 3. Drop off occurred much quicker from exposed foliage on platforms than from trees. The knockdown pattern can only be estimated because many affected larvae became lodged in the foliage where they could not be tallied until the final count. If the pattern of knockdown was similar to the pattern of actual drop off, it can be estimated by apportioning the total number of dead or paralyzed larvae in the final tally according to the drop off pattern. The knockdown pattern so calculated is shown by the broken lines in figure 3.

More than 90 percent of the drop off on platforms occurred during the first 30 minutes after spraying; therefore, the estimated pattern of knockdown is probably nearly correct for larvae on exposed platforms. However, we can only speculate on the knockdown pattern for trees. If multilayered foliage on the trees partially screened the spray, knockdown could have been delayed either because the amount of spray which came in direct contact with the larva initially was inadequate for rapid knockdown or because the pyrethrins displayed residual activity on the foliage. In either case a gradual pattern of knockdown would have occurred similar to the estimated line for trees in figure 3. If there was no screening effect, the pattern of knockdown on trees may have been similar to that on exposed platforms, in which case the delay in drop off might have been due to larvae being temporarily lodged in the wet foliage.

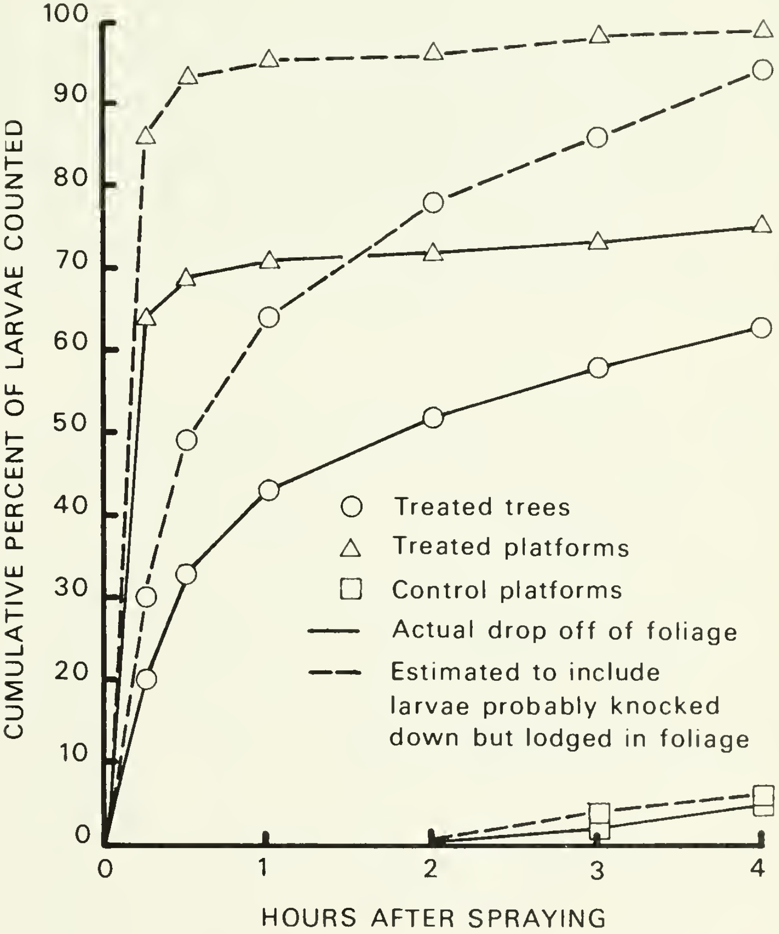

Figure 3.--Drop off from foliage and estimated knockdown of hemlock looper larvae in relation to time after spraying.

Nineteen hours after treatment, a final examination and classification were made of larvae collected during the test. The conditions of these larvae are summarized in table 1. On the treated platforms which had been fully exposed to the spray, 96 percent of the larvae were either dead or paralyzed 19 hours later. By comparison, only 70 percent of the larvae from trees were dead or paralyzed, and 29 percent appeared to have recovered or were unaffected. Total mortality of larvae on the platforms was almost twice that of larvae on trees. These results imply that the lag in drop off of larvae from trees shown in figure 3 was probably due to the initial screening effect of branches which delayed knockdown, not to lodging of larvae in the foliage.

The severity of injury to larvae in relation to the time that they dropped off the trees may be an indication of the differences between the effect of direct contact and delayed action. As shown in figure 4, the most severe injury was incurred by larvae that were knocked down within 15 minutes after treatment. These larvae had most certainly been in direct contact with an effective amount of the initial spray. Moreover, their rates of death, paralysis, or recovery were somewhat similar to those of larvae on exposed platforms (table 1). Larvae that dropped from the test trees at later times seemed to be less severely injured, as indicated by an increase in their recovery rate and a general decline

Table 1.--*Condition of test larvae 19 hours after spraying*

Treatment and condition	Dropped off foliage		Remainder		Total	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
Trees:						
Dead	144	22	95	25	239	23
Paralyzed	345	53	143	38	488	47
Recovered	163	25	78	21	241	23
Unaffected	0	0	64	17	64	6
Total	652	100	380	101	1,032	99
Treated platforms:						
Dead	80	39	32	46	112	41
Paralyzed	121	59	30	43	151	55
Recovered	3	1	5	7	8	3
Unaffected	0	0	2	3	2	1
Total	204	99	69	99	273	100
Control platforms:						
Dead	2	15	0	0	2	1
Paralyzed	0	0	0	0	0	0
Recovered	11	85	3	1	14	5
Unaffected	0	0	249	99	249	94
Total	13	100	252	100	265	100

in the rates of death and paralysis (fig. 4). Such evidence suggests that there was late knockdown due to delayed or residual action of the insecticide, but that the severity of injury diminished with further lapse of time after treatment.

CONCLUSIONS

Our test demonstrated that the stabilized formulation of pyrethrins could be extremely effective against the western hemlock looper when delivered under a field situation. However, degree of effectiveness seemed to be influenced markedly by the initial amount of exposure to the insecticide. Knockdown was faster and mortality was higher among larvae fully and directly exposed to the spray than among larvae partially screened in the foliage of small trees. Moreover, rate of recovery was considerably higher among larvae that did not receive ample spray for rapid knockdown. Effectiveness of the stabilized pyrethrins in a natural forest situation will obviously depend to a large extent on the thoroughness with which the insecticide can be delivered to the target insect.

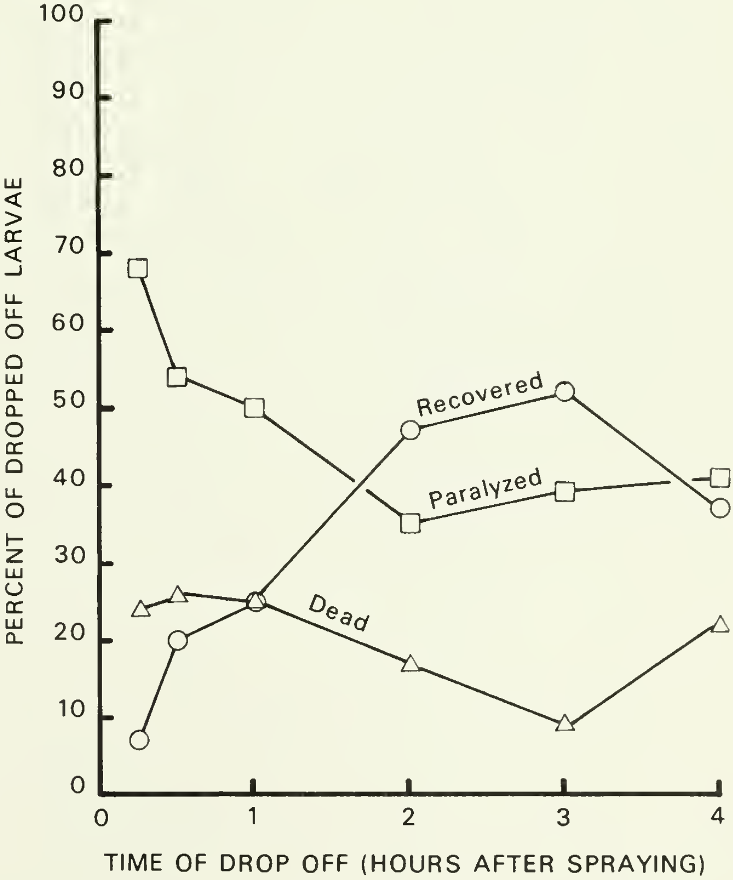

Figure 4.--Condition of larvae 19 hours after spraying in relation to time of drop off from trees.

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